

# Houston/Galveston, TX

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## Hurricane Ike (September 2008)

### Storm Surge Estimates from Damage Surveys (updated 18 October 2008)

#### 1. Introduction

Hurricane Ike made landfall over the eastern end of Galveston Island just after 2 AM on Saturday 13 September 2008 as a category two hurricane on the Saffir-Simpson scale. The storm then tracked northward across Galveston Bay. Ike was a very large as it moved across the Gulf of Mexico and made landfall, with tropical storm force winds (34 knot, 39 MPH) extending 275 miles outward. Ike's large wind field contributed to storm surge values well in excess of those normally associated with a category two storm.

The National Weather Service (NWS) dispatched 4 teams to survey damage due to wind and storm surge across the region. In cases where high water marks were present, either on fences or buildings, or indicated by debris lines on sloping terrain, the teams estimated the height of the water level relative to mean sea level if a nearby reference elevation was known or could be reported by the property owner, but these estimates were subject to error at the teams did not have sophisticated survey equipment to make quantitative elevation estimates. Survey teams from other agencies, with more sophisticated GPS equipment, made more quantitative measurements of high water marks. These groups included FEMA, USGS, and the Harris County Flood Control District (HCFCD). The results of available estimates and measurements are summarized by region below. As more information becomes available, surge estimates may be revised.

#### 2. Gulf Coast

##### a) Bolivar Peninsula

Towns on the Bolivar Peninsula were heavily damaged by wind and storm surge, with an estimated 80 to 90 percent of the homes in the communities of Crystal Beach, Gilchrist and Caplen destroyed. The level of destruction, relative scarcity of water marks, and the damaging high surf component on top of the surge, make it difficult to estimate surge quantitatively. HCFCD reported high water marks in the 12 to 16 foot range. NWS survey teams found some indication that water reached the 20 foot level in a few places, due to surge but also possibly due to waves on top of the surge. The tide gauge at Rollover Pass on the eastern part of the peninsula measured a water level departure or storm surge of 11.06 feet and was rising at 05:48 UTC, or 12:48 AM CDT, just before the time it stopped reporting at 1 AM CDT (Figure 1). From available data, would estimate surge of 12 to 16 feet on the Bolivar Peninsula, and possibly higher in spots. Will be able to refine these estimates as additional surge measurements become available.

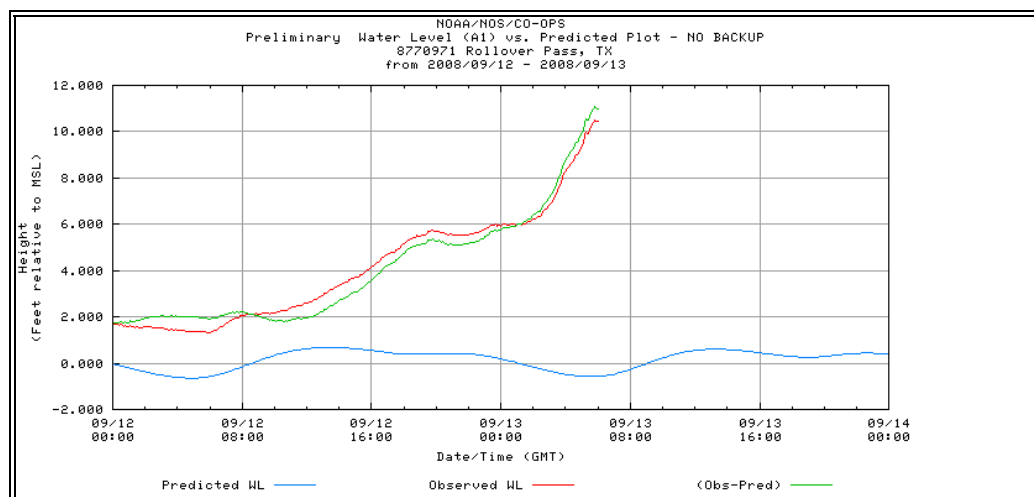
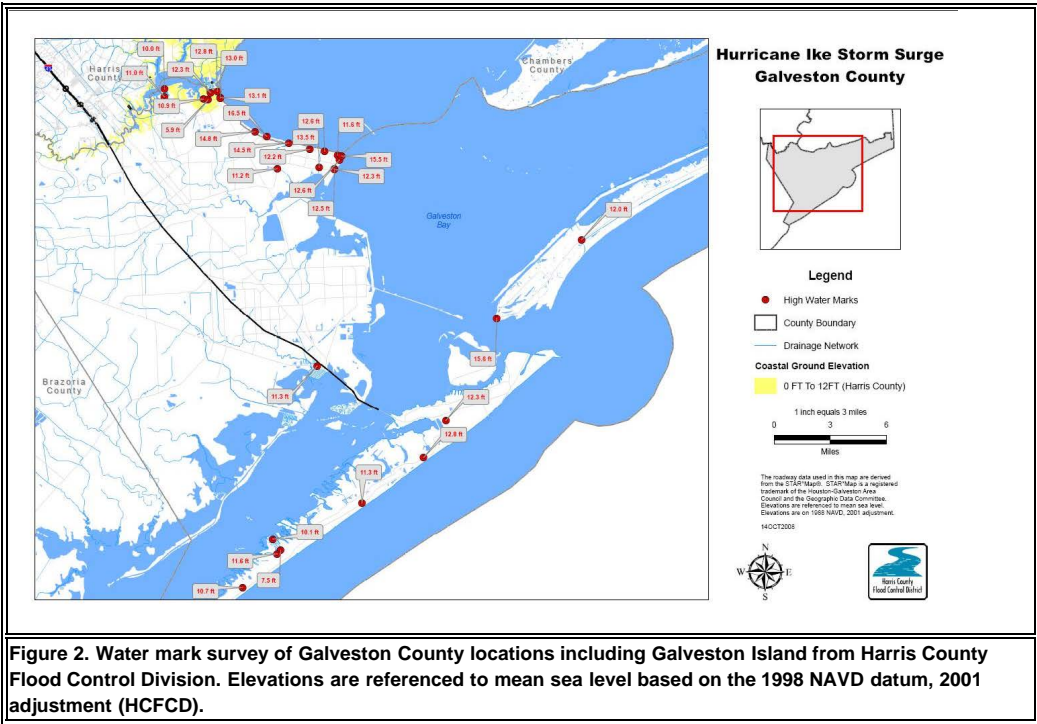


Figure 1. Observed water level (red) and departure from expected due to surge (green) for Rollover Pass.

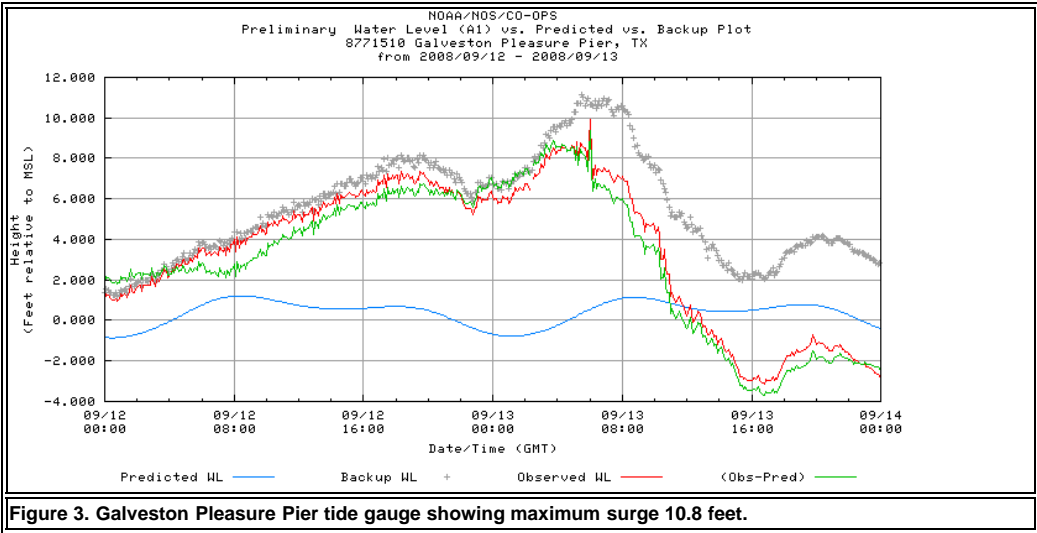
Sensor stopped reporting before reaching peak surge.

b) Galveston Island

High water marks from HCFCF survey on Galveston Island were generally in the 10 to 13 foot range which was consistent with estimates from the NWS survey. Surge values were generally closer to 10 feet over the West End, and in the 12 to 13 feet over eastern portions of the island

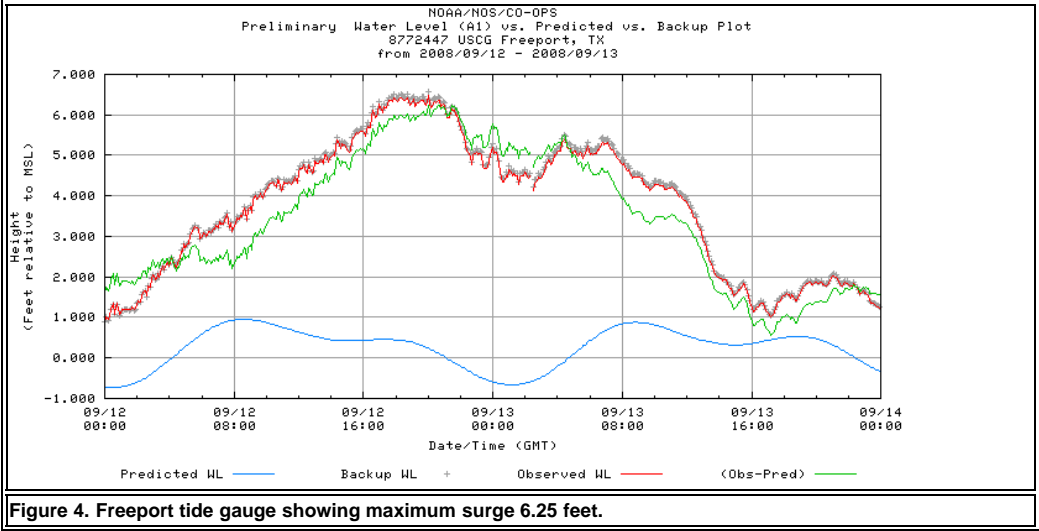


The backup sensor at the Galveston Pleasure Pier gauge measured a peak water level of 11.6 feet NAVD (grey line) for a peak surge of 10.8 feet (Figure 3). The primary sensor (red line) appears to have failed with water levels beginning a rapid decrease as the hurricane approached.



c) Brazoria and Matagorda Counties

Surge values were estimated by NWS survey teams to be 6 to 8 feet near Surfside Beach although there was uncertainty in the elevations there, and were few good water marks. Farther down the coast, results from damage surveyed in the Sargent area found evidence of a five to seven foot storm surge in areas outside of the Intracoastal Waterway, with lower water level evidence along man made canals running inland. Despite the lower surge values in this area, beach erosion was severe, with a concrete retaining wall emplaced to help preserve the beach becoming exposed. The wall had not been visible since it was constructed in early 1998. Tidal gauge near Freeport indicated a maximum storm surge of 6.25 feet several hours prior to the landfall of Ike up the coast.



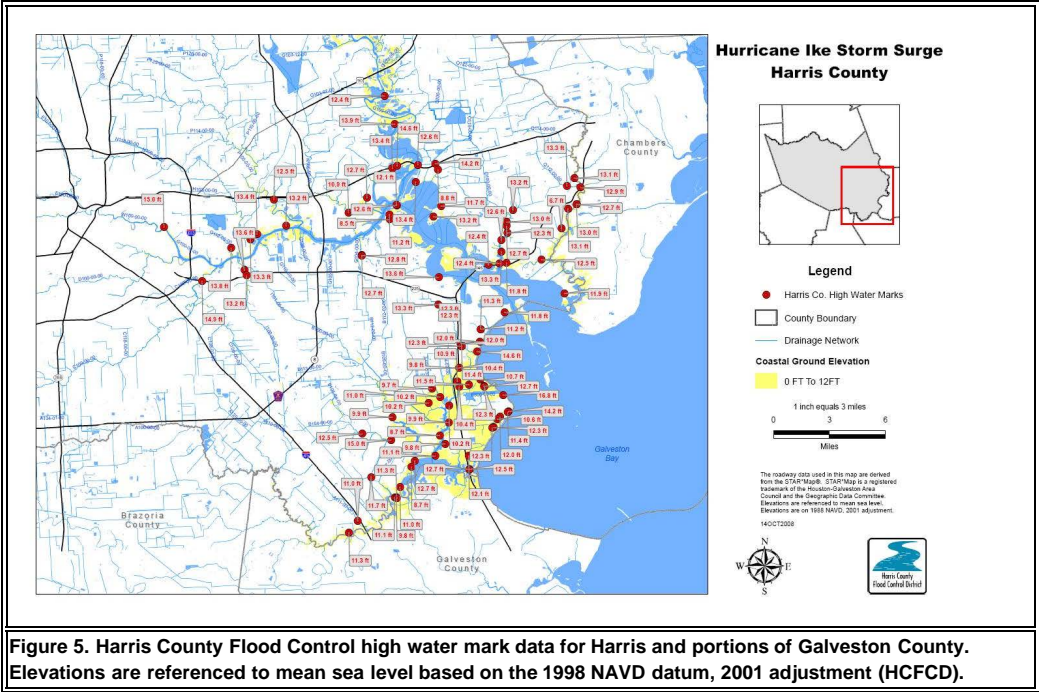
3. Galveston Bay

a) Chambers County

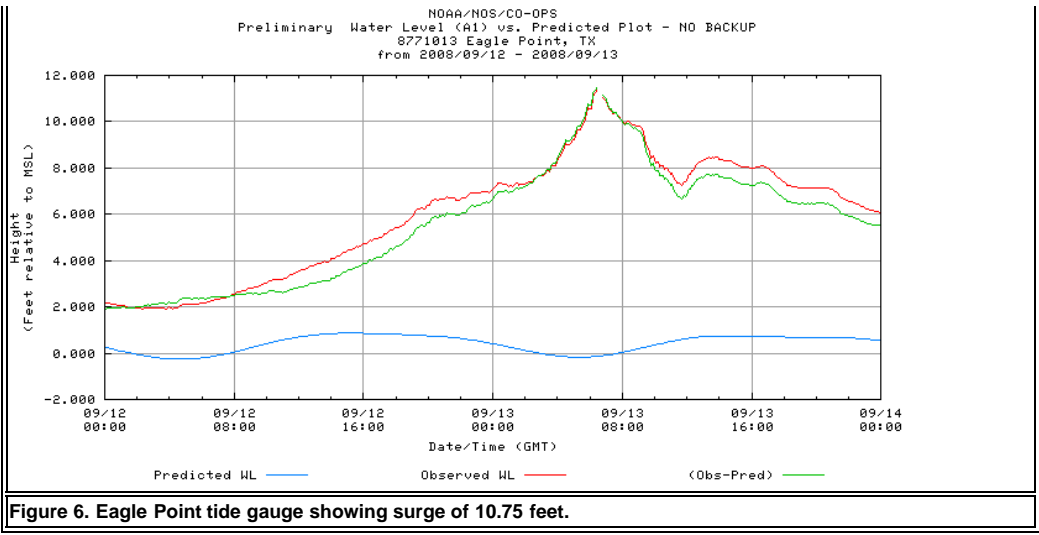
Estimates of storm surge ranged from around 12 feet at Smith Point, to the 15 to 20 foot range near Anahuac, Oak Island, and in the Trinity River basin near Wallisville and the Interstate 10 Bridge. Large debris piles were found from wreckage that had washed over East Bay from the Bolivar Peninsula. These debris piles were nearly 20 miles inland from their likely origins. HCFCD managed to record water marks near 17 feet between Anahuac and Oak Island, and another mark near 13 feet at Smith Point consistent with these estimates. HCFCD was unable to capture more water marks due to cellular communications outages limiting their GPS capability, but it is possible these surge estimates can be refined when new surge measurements become available.

b) Harris and Galveston Counties

HCFCD conducted a detailed high water mark survey and analysis along the western shore of the Galveston Bay and near the adjacent bays, lakes and rivers. Their findings are shown in figure 5.



Surge values of 10 to 13 feet were common along the Western Bay and Clear Lake. The communities of Shoreacres, Seabrook, Kemah and San Leon were especially hard hit by a combination of storm surge and wave action as evidenced by damage to structures, roads, piers and concrete riprap along the shoreline. Significant water was observed in the towns of Nassau Bay, Clear Lake Shores and Taylor Lake Village, due to high water entering structures from the surge getting into Clear Lake and Taylor Lake respectively. The gauge at Eagle Point near San Leon measured a maximum surge of 10.75 feet.



4. Summary

Hurricane Ike, a large category 2 storm at landfall, generated a significant storm surge along the Gulf Coast and along the Galveston Bay and adjacent tributaries. Surge values along the Gulf Coast were estimated to be around 5 to 6 feet near Sargent, 6 to 8 feet near Freeport and Surfside Beach, generally 10 to 13 feet along Galveston Island, and 13 to 17 feet along the Bolivar Peninsula. Along the western shore of Galveston Bay, and the adjacent Clear Lake, maximum surge also ranged generally from 10 to 13 feet, with surge values of 15 to possibly 20 feet over portions of Chambers County. These estimates will be refined as more data become available.



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